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Published in:
Digital Creativity

DOI:
10.1080/14626268.2018.1516676

Publication date:
2018

Document Version
Peer reviewed version

Making Art from Self-Tracking Cycling Data

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This paper describes a collection of data-driven aesthetic explorations that investigate the concept of 'cycling as art practice' made possible through the use of self-tracking tools while journeying by bicycle into the landscape. The explorations draw upon the philosophy of the 'Walking Artists' and the concept of 'the dematerialization of the art object' as counterpoints to the Quantified Self Community, which aims to visualize previously invisible aspects of our daily lives for the purposes of positive self-monitoring. In doing so it begins to draw attention aesthetically, and philosophically, to the way in which representations of our experiences, particularly of landscape, can be formed through the use of such technologies for generative art purposes.

Keywords: Quantified Self; Data Art; Generative Art; Cycling Art

Introduction

Artistically speaking the notion of a 'Quantified Self' offers opportunities for art making that explores the boundaries between experience and representation that challenges the accepted norms of how experience is represented. In recent years the Quantified Self (QS) movement, and self-tracking in general, has grown exponentially, largely motivated by a popular desire for self-improvement, health and well-being ({ HYPERLINK "http://quantifiedself.com/" }). Choe at al (2014) have presented some clear insights into the wants and needs of the QS community as well as identifying some of the common pitfalls that non-professional data trackers encounter (e.g. tracking too many things and difficulties in combining data sets). Alice Thudt's work on autobiographical visualisations and visual mementos has provided some very useful

examples of system design that attempts to take the subjective experience of memory into account in relation to a range of objective/subjective data sources (Thudt, 2018; Thudt et al, 2015; Thudt, Baur and Carpendale, 2014). Similarly, the recent work of Huang et al, have focused on developing a taxonomy of design dimensions for tools to support data analysis in the non-professional setting (Huang et al 2014). There is also an additional body of work within the domain of 'life-long user modelling' that tracks similar issues such as privacy/sharing, lack of control over aesthetics and difficulties in combining disparate data sets (Kay and Kummerfield, 2009a, 2009b; Gakhal and Bull, 2008; Bull and Kay, 2009). However, little has been done to explore the relationship between data tracking, representation and sense of experience within this context. Arguably, it is only in the art world that self-tracking and data gathering technologies are being explored philosophically or aesthetically in order to understand how they relate to our experiences. Artists such as Lupi and Posavec have popularised personal data visualisation with their 'Dear Data' project (Lupi and Posavec, 2016). But other artists, such as Ellie Harrison or Lauri Frick have been working with this kind of data for much longer and in more depth (Harrison, 2009, 2006, 2003; Frick, 2014-15a, 2014-15b; Istomina, 2015). The relationship of their work to the QS movement and user modelling in particular is discussed by the author in a forthcoming paper (O'Neill, forthcoming). Additionally, other researchers have been active in this domain exploring self-tracking and data within the context of art for some time (Fan, Forlizzi and Dev, 2012,; and Runge at al, 2016).

The problematization of the relationship between experience and representation has an interesting history within the conceptual art of the 1960s-70s, which provides rich ground for the development of an art practice seeking to explore a sense of experience more deeply. Moreover, nearly fifty years on, the development of self-

tracking tools has enabled the author to develop a practice focused specifically on the experience of cycling and landscape. This practice aims to combine conceptual art making with self-tracking technologies in order to explore new ways in representing the experience of cycling through the landscape. The seemingly opposite trajectories of conceptual art and quantified self belies their similarity, allowing for the emergence of an art practice that both capitalizes on and questions the intentions of both.

In the middle of the 20th Century, the art world became preoccupied with the notion of "the dematerialization of the art object" as Lippard described it (Lippard, 1973). The direction of this kind of art, which emerged as part of conceptual art making, characterized the intention of artists to free themselves, politically, economically and aesthetically from the tyranny of the art object and its associated gallery driven norms. This resulted in new forms of art practice that moved the locus of art making outside of the studio and challenged the capacity of the gallery to contain it. Foregrounding the idea, (or the experience), over the object that represented it, lead to a move away from the more formal concerns of Minimalist sculpture and painting and towards the production of ephemeral art objects such as events, happenings, recordings, photographs and documentation. This radical approach to art making decentralized the art object and while it may not have dematerialized altogether, the focus on the ephemeral aimed to reveal the ideas and experiences behind art making rather than trying to be art in themselves. Of course these ephemera are still objects but they lack the solidity or monumentality of previous art forms. They are numerous and fragmented, multifaceted and incongruent. They offer multiple perspectives on content and take myriad forms rather than being singular and coherent, they challenge the very idea of what art can be.

One such practice was 'Walking Art', pioneered by Richard Long and Hamish Fulton. Very simply, the walking artists made art by, through and about walking.

Walking was their art [e.g. "A Line Made by Walking, Long, 1967]. They made walks, they brought things back from walks, they photographed things on walks, they reported on walks, and they used the gallery space as a way to communicate about their experiences of walking. Some of which took place in very exotic remote wilderness, some in the mundane urban environment. Hamish Fulton famously stated that "An object cannot compete with an experience" (Fulton, 2001), foregrounding the esoteric primacy of the experience of the artist and framing the exoteric material produced as echoes of that experience. The purpose of which essentially was to remind us about how deep and unfathomable our experiences can be and how impoverished our representations of them are. A photograph of a mountain, no matter how good it might be, is not the experience of being there but a reduced or diminished representation of it.

There is an important point of connection to be made here between this type of art making and that of 21st century notion of the Quantified Self. Emerging from the proliferation of smart phones and personal computing, the Quantified Self movement has pioneered the idea that we can use these devices to gather data about our activities and ourselves and use them to reflect upon who we are and who we want to be (Wolf, 2009). Of particular importance is a set of devices called personal fitness trackers. These devices, a combination of smart phone apps and physical wrist worn bracelets, gather data about our daily movements, levels of activity, heart rate, sleep as well as dietary habits and alcohol consumption to name but few. Driven by a 'well being' agenda that aims to help individuals lose weight, change shape and achieve healthier life styles, these devices are having a huge impact on society at the moment.

There are two things that are interesting about these devices as an artist. Firstly, it is interesting to think about how an artist can utilize the capabilities of tracking data as a way to document their experiences, in a similar way to Long and Fulton using

photographs. Arguably, data is the ultimate dematerialized artwork, at least in the sense that it has the potential to represent some aspect of my experience of reality usually through numbers (e.g. 58 bpm represents my current heart rate as I write this paper).

Secondly, the fact that people are signing up to track their data in such detail and share it with corporations and other people without really considering the implications of this as a form of representation is an interesting social phenomenon (Lupton, 2106). If Fulton is right, and an object cannot compete with an experience, then in what way can personal data represent a self? Surely the Quantified Self movement is engaged in producing reductionist, diminished representations of us that are of a very particular type and despite embracing the positives of such devices, this has implications for society. By foregrounding the experience and dematerializing the object the walking artists drew our attention to what is beyond our representations. Conversely, by materializing that which was previously undetectable, arguably, the Quantified Self movement (despite it's good intentions) and their self-tracking devices are focusing our attention on the data and ignoring that which is not digitized.

However, if the photograph of the mountain is not the mountain, and the map is not the territory (Korzybski, 1933), then it follows that the data of the person is not the person. So what is it? What does this data show about our experiences, our ideas and us? What are it's strengths and weaknesses; what does it add and what does it take away from our experiences; how does it form and inform the representations we are making of ourselves, and how much control do we actually have over this dematerialized media? As an artist, the author aims to confront this issue and explore the possibilities of what it means to use this new representational technology as a form of expression particularly in relation to the experience of cycling in the landscape.

Walking Art

Since its inception in the 1960s, Walking Art has grown into a genre of its own. Although not written from an exhaustive historical perspective, Karen O'Rourke's books "Walking and Mapping" (2013) provides an excellent and very thorough insight into the range of work that has been produced by artists, literally, following in Long and Fulton's footsteps. Significant ideas from this book have influenced the author of this paper including the development of walking protocols that establish a process or set of rules for making walking art, as well as the use of 'locative media' to track or trace a path through an environment. This next section outlines some of those projects mentioned in O'Rourkes book.

Long was a pioneer of the protocol (Long, 1994). His early work was often characterized by using maps, on which he would draw lines and circles that would determine the shape of his walk. He would then act out the shape of the walk by enacting the rule of following the shape of the line on the map in the real world. At times this wasn't possible, as the terrain would prove impenetrable e.g. a cliff face impossible to traverse. However, by and large this became a common method for practicing walking art. Over time such protocols became more complex e.g. A Walk of Four hours and Four Circles or Old Year New Year Walk, a walk of 80 miles in 24 hours (the last 12 hours of 1992 and the first 12 hours of 1993). Sometimes the artwork was the map itself. At other times it was photographs taken during the trip or stone circles made on location or sometimes even just the statement of facts about the walk itself rendered in large vinyl letters on a gallery wall. Generally though these ephemeral entities were often gathered together in book form to provide a specific documented outcome (Long, 1994).

Malone and Adams, used similar principles when making their work JFK in 1997. Their protocol was to walk non-stop from Downtown Manhattan to JFK Airport, following the straightest path possible. Along the route they would share a camera, when one of them saw something that interested them he would take a photograph and immediately pass the camera to the other in order to take a photograph of what was directly opposite. The result was 243-paired sets of photographs that document their 11.5-hour journey across various New York neighbourhoods. Again the outcome took the form of a book (Malone and Adams, 1997).

Similarly, Tixador and Poincheval traced a 750 kilometer line from Nantes to Caen and Caen to Metz using a compass as their guide. Their aim was to reach the art school gallery in Metz for the opening night of their show. When they arrived, tired bedraggled and unkempt, straight from the tip, they showed unedited footage of what they had filmed with their video camera along the way. Later outputs consisted of an edited video and an illustrated travel diary that documented their experiences.

In each of these cases, and many more besides, the notion of walking to a set of rules is the characteristic factor that shapes the walks, sometimes literally, sometimes figuratively, and always experientially. Deciding from the outset that a particular protocol should be adhered to is an interesting constraint to set upon making art. It is a very useful one that has its roots in the programmatic art of Sol Le Witt and others from the 1960s. This approach is of course highly suited to digital technology, which relies on programming, [more of which will be considered in the methods section of this paper]. Additionally, it is worth noting the way in which these artists documented their work. Despite foregrounding the esoteric, the art of walking is only known through the exoteric materials that the artists provide as proof of the experience. As such only certain things can be revealed about such experiences.

The use of digital technology is, of course, the other strand of influence that is essential to the development of the authors practice. The biggest influence being the advent of GPS enabled devices. Early examples of walking practice that explored this technology may seem rudimental now but in their time were groundbreaking.

Masaki Fujihata's Impressing Velocity [Mount Fuji], (1992-94) is one such example. Using a head mounted Video camera, a GPS receiver and a laptop in a rucksack he tracked his journey as he climbed mount Fuji. By recording changes in the speed of his climb he was able to use this data as a variable to affect a 3D model of the volcano upon return to his studio. The resulting outcome was a radically distorted 3D image of the volcano that reflected the drop in his speed as he neared the summit.

Much of this kind of data is now readily recordable through the smart phones we all carry around with us today. This is the kind of device that has enabled the author to realize his artistic intentions and is the sort of device that Stephen Wilsons Telepresent (1997) was precursor to. Like Fujihata, Wilson created a magic box that contained a computer, a wireless modem, a GPS receiver and a digital camera that automatically uploaded images to a website. This box was then given as a present to someone else with strict instructions to pass it on to someone else once they had finished with it. The idea was to create a device that automatically kept track of the networks of friendship that were created by gifting the device across a community. While we don't necessarily gift our phones in the same way as Wilson envisaged, the power to create this kind of work is now commonplace. Indeed, it is the explosion in the power and ubiquity of such devices that intrigues the author. Of particular importance is the way in which these devices now have multiple applications that can gather a range of discrete information about the user that was hitherto unimaginable when the walking artists first began to engage with locative media.

Methods and Materials

Putting technology and protocols at the heart of creative practice requires a certain amount of consideration and organization before setting off to actually make any work. Rather like planning an expedition, one has to consider the pros and cons of the particular technologies involved as well as how the rules of engagement will fit with their capabilities. This in turn has a huge affect on the kind of outcomes that emerge from the process once it is put into practice.

Figure. 1. Bicycle as tool for experiencing landscape.

In the case of the author there had been a long-term desire to make artwork out of the experience of cycling in general and Mountain Biking (MTB) in particular. The reason being that cycling is a particularly fleeting and ephemeral experience that is constantly changing over time, taking you across different kinds of terrain and physically challenging you at every turn of the pedals. It's not easy to capture the experience of cycling. Additionally, research experience of trying to understand the

‘sense of place’ in virtual environments during the EU funded BENOGO project (2002-05) was formative in grounding much of the authors thinking about experience and technology (Benyon et al, 2006; McCall et al 2005). The theoretical work of Edward Relph (1976), Yi Fu Tuan (1977) and Martin Heidegger (1962) were deeply influential to the BENOGO project and continue to inform the author’s theoretical point of view (O’Neill, 2009, and in preparation).

The technology of the bicycle in itself has given a huge range of different experiences to the author. From long road rides, cross-country racing, MTB marathons and epic multi day tours of the wilds of Scotland the author has experienced a vast range of landscape that would not be possible on foot. Like the car, the bicycle offers range and speed over the drudgery of walking, but unlike the car the bicycle is still crucially human powered. It requires effort to get anywhere and as a result it has it’s own limitations and potentials that make it unique as an artist’s tool. Like any tool it can be considered as an extension of our senses and our body. What sense of freedom we gain in terms of range and speed over walking we lose in terms of submitting to the rigours of cycling. One must sit and pedal the bicycle to move and one must steer to find our way. Effort and fitness is essential to achieving range or speed, and this is challenged at every turn by terrain and weather. There is also always the danger of falling off and injuring oneself, quite badly.

So, if the bicycle offers an alternative way of experiencing landscape to walking, what does this mean for art practice? In short the artist has to consider the bicycle as a tool for making art and rather than just going out for a bike ride, (s)he has to engage with cycling itself from a different frame of mind. This is difficult because, as just stated, pedaling and controlling the bike take a great deal of effort and skill especially in off-road terrain. So if one submits to the process of cycling as part of the protocol for

making art then it is digital technology that comes to the rescue in terms of enabling the automatic capturing of data about that experience.

Using two smart phones has become the authors preferred mode of operation. IPhone 1 (Figure 2), is used to keep track of the route data. Running an application called Cyclemeter allows the author to track his GPS coordinates, his speed, altitude, weather conditions and with the help of additional sensors, heart rate, power output and pedaling cadence. The aim here is to capture as much data as possible while out in the field to be utilized later back in the studio.

Figure. 2. Screen shot of the Cycle meter app.

The second phone has two purposes. Sometimes it is strapped to the authors back to capture data from the iPhones internal motion sensors that provide six degrees of motion, gyroscopic forces and acceleration in the xyz planes. At other times it is used

as a camera. [Note: the data from iPhone 2 will be discussed in a companion paper to this one, as there isn't sufficient space to do so here].

Bringing all of these pieces of technology together, the bike, the phones, the apps, the camera is only half of the story though. While this assemblage of artefacts provides a framework for engaging in fieldwork it doesn't guarantee the production of any artwork. Data gathered in this way is still dematerialized until it is given some kind of form as an outcome. This is where Processing comes in.

Processing is a well-established software platform for digital artists to use in terms of making visual art through programming (Reas and Fry, 2007). It's range and scope is vast and ever growing thanks to its open source ethos and the number of developers that contribute libraries and extensions to its capabilities. For the author it is Processing's capacity to draw together data from multiple streams as well as it's visual rendering that makes it an attractive and useful tool. When thinking about the cycling protocol for making art one has also to think about how Processing fits into the 'process'. It can't be an afterthought; indeed, it was the revelation that processing could potentially be used to visualize the authors existing data that lead to the idea of consciously making art through cycling in the first place. Initial experiments with preliminary data from short bike rides proved that visual outcomes could be produced from cycling data that was unlike anything else seen before. After that, protocols for art practice were developed through trial and error as the various configurations of iPhone, app and software were tested out on local rides. The work presented in the next section represents the initiation of this investigation and traces the evolution from early experiments to full-blown data driven cycling art practice.

Outcomes: Proving the Concept

The initial concept for producing outputs based on cycling data came from considering the way in which training data is used by professional cyclists. Training for cycle racing is an arduous activity that requires not only a great deal of effort but a great deal rigour and accountability in terms of sticking to a training plan. Having raced MTB as an amateur at national level, the author has some experience of this. Increasingly, data has become a useful tool for cyclists to establish their progress towards key fitness goals at various times of the year. Key to this is the habit of keeping a training diary or regularly downloading data from smartphone tracking apps that record ride data (e.g. Strava or Cyclemeter).

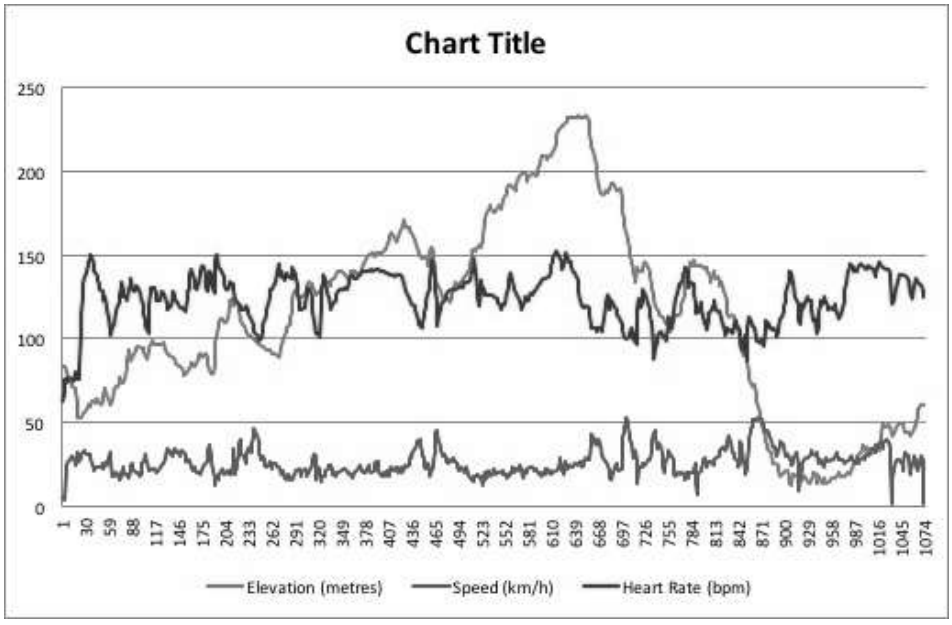

Figure. 3. Graph based Cyclemeter data output.

Recorded data is usually presented in graph format (Figure 3) and allows the rider to compare a recent training session against previous sessions to see if there are improvements in speed, endurance, threshold heart rate levels or peak power output.

Amongst the pro tour riders this level of information is crucial to their daily activity and its use is ubiquitous.

One key training session is the interval session. Usually this comprises of several hard to very hard burst of activity followed by shorter rest and recovery periods that follow a sequence. For example the author often uses an interval protocol like this: 10mins warm up, 8x3mins @>300watts, with 2mins recovery in between, 5-10mins cool down. A session such as this has a very clear pattern of activity and it is this pattern of activity that was the testing ground for early visualisations of cycling data (Figure 4).

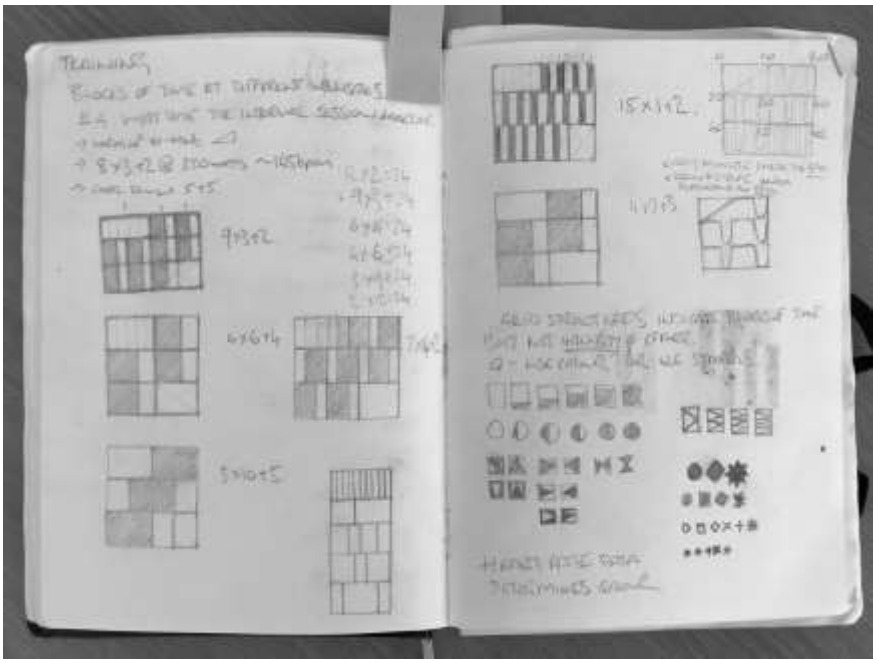

Figure. 4. Initial Sketchbook Ideas for Visualizing Interval Sessions.

The proof of concept was mocked up in Processing using random generated data to control the alpha channel of a predominantly red square. Random data was perfect for this task as at this stage the author was only concerned with ensuring each stripe could be differentiated from another. The logic being that if it works for random data it will work for real data. Figure 5, shows what this initial outcome looked like. The main

problem addressed here was how to fit data into a formal structure (square or rectangle) that felt coherent and also allowed the pattern of data to emerge visually within that structure. This initial trial highlighted problems of registration in terms of fitting the data to the frame of the square without repetition error or dead spots.

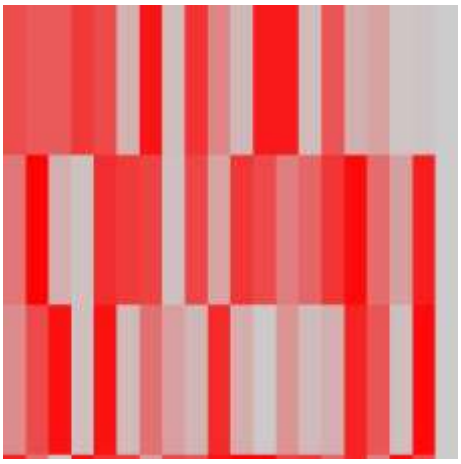

Figure. 5. Cycle Data Test 1: Random Data Stripes

The decision to use stripes to represent the data was motivated by an understanding of the work of the Concrete Artists from the 1940-50s, whose concerns with only the structure of painting resulted in many abstract pictorial experiments of a similar nature (e.g. Richard Paul Lohse, Max Bill, Theo Van Doesburg etc.) Conceptually, the Concrete Artists seem a long way from the walking artists but their interest in simple formal structures and rational approach to painting is not dissimilar to the protocols of the walking artists. Indeed, the Concrete Artists were the antecedents of Programmatic or Generative Art, paving the way for the likes of Harold Cohen's AARON automated painting machine and the artwork and theories of Margret Boden and Ernest Edmonds (Boden and Edmonds, 2009; Edmonds, 2013). Suffice to say, without going off track, that the work presented here draws as much on this line of artistic investigation as it does walking art as they both have common ancestry.

The use of random generated data was enough to give a sense of how discrete points of data could be rendered aesthetically in a sensible fashion. However, it was too far removed from the reality of the cycling data. Cycling data tends to change in an incremental fashion; altitude, heart rate and speed all rise and fall in a fairly regular way. Perlin data provided a much better fit for emulating this rise and fall within the experimental visual problem-solving phase. Figure 6 shows a much more even change in the data visualization.

Figure. 6. Cycle Data Test 2: Perlin Noise

Once the initial visualization problems had been ironed out and a stable form for the data had emerged, what remained was to test this out with real data. The software now represented the first stage in a protocol for visualizing all future data derived from cycling activity. Figure 7 shows the very first outcome using real heart rate data. As can be seen it looks very different. At this stage the use of the Alpha channel was abandoned and the code was rewritten so that incoming data would manipulate the intensity of the red channel itself. The number of rows and columns are determined by the size of the data sample, and each stripe represents one minute of time. The resulting image shows the eight distinct ‘interval’ periods of intense heart rate activity coupled with periods of rest and the warm up and cool down phases of an hours training session.

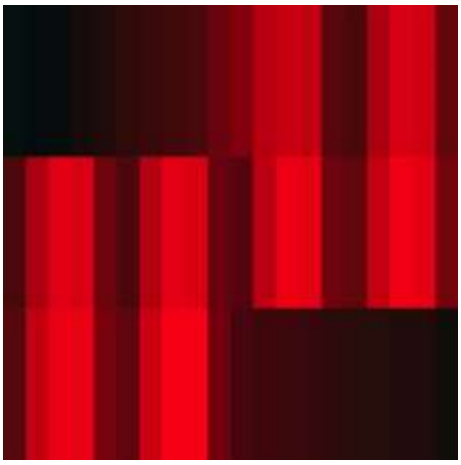

Figure. 7. Cycle Data Test 3: Real Heart Rate Data

So the concept was viable. It was possible to visualise cycling data in an interesting and aesthetic way. However, this was only one stream of data, what about the others? How should speed and altitude be included for example? The solution came by linking each of these sources to the other colour channels in RGB mode: Red for heart rate, green for altitude and blue for speed. This followed the conventions already adopted in the graphing and data visualisation systems of both Strava and Cyclemeter, and perhaps belies a hidden logic in that red links to blood and green links to the environment and blue has historical cultural links to the idea of speed (e.g. The land speed record breaking vehicles, Bluebird and Blue Flame). To achieve this mixing the data is drawn into Processing and code uses a mapping function to equate raw data to the 0-255 RGB colour range. The colour of each stripe is then dependent on the outcome values of each channel.

Figure 8 shows the first fully-fledged colour mixed outcome of three streams of data from an hour-long ride round the block where the author lives. There is an initial dark section that has hints of blue showing very little altitude or heart rate data but some speed, then shades of mauve and pink begin to alternate across the image at various intensities. As the ride was relatively flat with some minor altitude gain the green

channel has very little affect on the image. It is essentially a visualisation of the process of putting power through the pedals of a bike to gain speed over a certain distance. The variations in the colour are the variations in effort (red) mixing with speed (blue) over slightly undulating terrain (green).

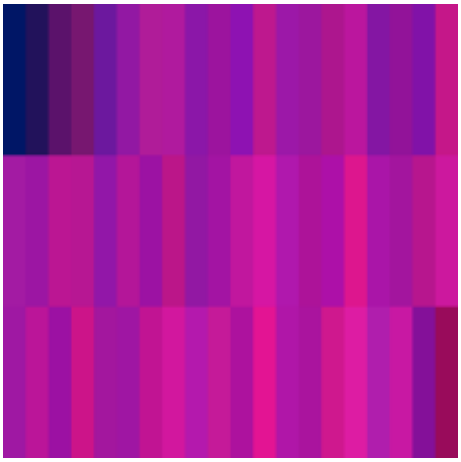

Figure. 8. Cycle Data Test 4: Mixing Real Data, Heart Rate, Speed and Altitude.

Results: Expanding the range

Having established a working prototype that was proven to work as a software protocol for visualising cycling data it became apparent that this process had the potential to be used to visualise any length of ride over any kind of terrain and in doing so the resultant visualisation should not only clearly represent that data but it should also begin to establish colour patterns for the kinds of experiences that cycling involves. For example purples, mauves and pinks tend to show that part of the cycling experience where the rider is putting in significant effort to travel relatively fast over even ground, the more intense these colours, the more intense the activity. Similarly, areas that are strongly blue-green in colour show where a rider is essentially travelling down hill at speed without putting much effort into pedalling. The more blue the colour that faster the rider, the more green the higher. Areas of strong yellow should highlight the highest

altitudes and greatest speeds, as the colours mix. Furthermore, areas of intense red-orange show where a rider has put greater effort into cycling up hill; the stronger the colour, the steeper the hill and the harder the work.

The next phase of exploration required the author to engage in much longer rides to see how the system would cope with visualizing such a broad range of data. Figures 9 and 10 are examples of the kind of variety that the software protocols were able to visualise.

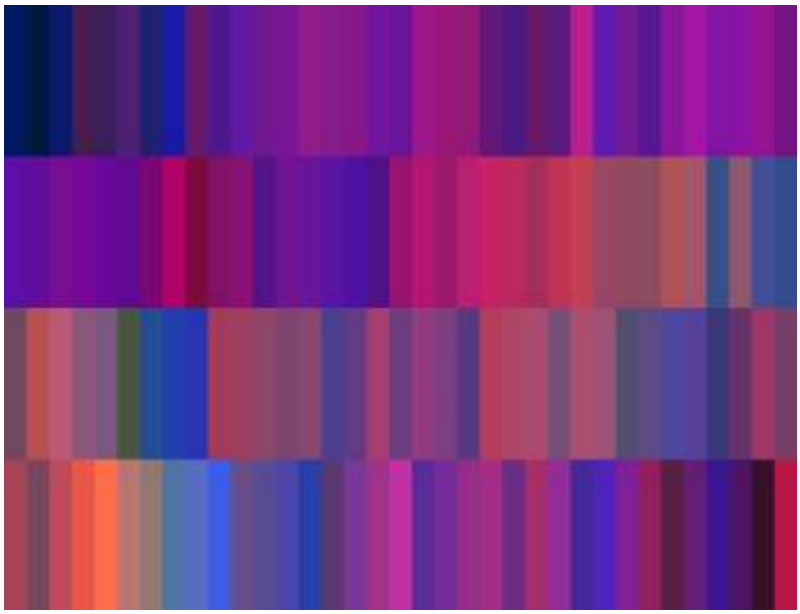

Figure. 9. Carrot Hill 1: A 61km Road Ride, 23/11/2014

Figure 9 is a visualization of a 61km road ride around a common route that the author uses for training purposes. The first thirty or so minutes of the ride are essentially pan flat as they take the rider out along the coastal cycle path between Monifieth and Arbroath on the East Coast of Scotland. Upon reaching Arbroath, the route turns inland and so begins the uphill portion of the ride. There are some testing efforts at around an hour or so and then the terrain begins to vary between short and sharp climbs coupled with fast descents. Carrot Hill is the high point of the ride, which is a brutal climb coming near the end with a longish downhill and steady but undulating ride back home

to the finish, which is a very short steep incline. The image produced by the software actually does a very good job of representing these particular aspects of the ride once you know how to read it. The steady sections are all mauve and purple, the harder up hill sections more red and brown and the fast down hill sections are very blue. The climb up Carrot Hill is depicted in strong oranges and there are two very dark segments at the start and finish where the rider had to stop at traffic lights to cross the road.

Figure 8 is an entirely different kind of ride. It is a 58km off-road MTB race. It is clear from the intensity of the colours that this was a very different kind of experience to he previous ride. First off the location of the event was a place in Scotland known as the Trossachs, which is characterised by steep hills and forest paths, which would be a challenge to any rider. This is immediately apparent in the increase of lighter oranges and pinks portrayed in the image. To an extent these are caused by more green in the mix, as there is more altitude in the data because we are further inland and higher up. But more significantly the intensity of the colours is caused by the significant rise in heart rate that the conditions caused in the author. The higher the altitude, the more the climbing the harder the rider works to reach the top. That coupled with the fact that it was a race meant that the author was putting in his best efforts to travel as fast as possible over the difficult terrain to reach the finish in as fast a time as possible [Note: the author recorded the 3rd fastest time of the day at this event].

Figure. 10. Callander: A 58km MTB race, 11/04/2014

It is worth pointing out then that the systematic approach presented here to making art through self-tracking cycling data is sensitive enough to ensure that the unique properties of every individual ride are maintained. For example if we compare Figure 9 with Figure 11 we can see that these two images represent the same ride around the same route only thirteen months apart. There are obvious similarities between the images. Similar groups of colours appear at similar points in each image but they are subtly different. So while the terrain is the same, i.e. the green altitude profile of the colour mixing is unchanged, the speed and effort of the rider is subtly different. This may reveal a number of factors that underlie the differences in the image, e.g. the fitness and energy levels of the rider.

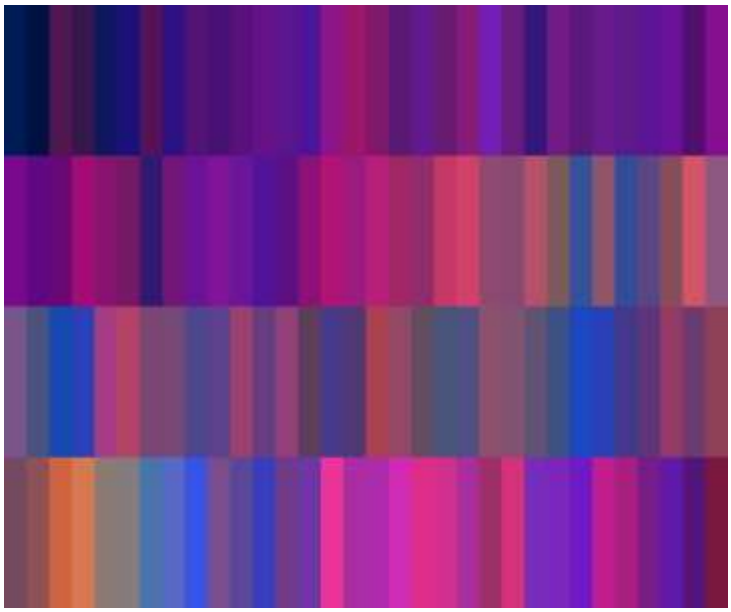

Figure. 11. Carrot Hill 2: A 61km road ride, 27/12/2015

It is well known that professional cyclists come in and out of 'form' throughout their cycling year as their training begins to take effect on their performance. Undoubtedly this is reflected in the data they output. So too here with the authors own work. The time of year the image was taken may reflect at what stage of fitness he was at and changes in the red value of the images would reflect his strengths and weaknesses as he battles to cover the terrain. Likewise, the blue value would also alter, as a lack of fitness would be immediately apparent in a drop of speed.

Additionally, there are other external factors that have to be taken into account most notably the weather. Cycling on a windy day is much harder that cycling on a calm day. Thus images with more intense pinks and purples and less blues would reflect the extra effort needed to cycle against the wind. Precipitation can also have a dramatic effect on speed and heart rate. Take Figure 12 for example. This image is again nearly the same route as the other two. The greatest significant difference between this image and the other two is that this ride took place in terrible winter conditions. During the first half of the ride it was windy and raining, which made progress slow and effortful,

accounting for the upsurge in strong pinks and mauves. However, during the second half, which is characterised by the increase in green, the rain turned to snow and actually made it impossible to continue cycling around the route. At one point the author had to take a diversion, dismount from his bike and push the bike downhill as it was so unsafe to ride any further. The increasing green to dark section shows this icy descent capturing the change in altitude; drop in heart rate and lack of speed.

Figure. 12. A 60km road ride in snow, 29/11/2015

Discussion

It should be made clear that each of the images represented are designed to be blown up proportionally to about three times their original size. This can result in images anywhere between 2 and 6 feet across depending on the amount of data. They are then subsequently printed on canvas and wall-mounted like paintings. The interesting thing that Figures 9-12 reveals is just how different cycling experiences can be. While the data is represented in a seemingly abstract way, the fact that the data is derived from a real world experience means that not only are they true reflections of that experience but of the reality that shaped it. There is no iconic resemblance to the places visited on

the rides; only streams of photographs or video footage could capture what was seen. However, although the representation is reductionist, as discrete points of data tend to be, there is a direct relationship between the symbolic representation of the image and the experience of the rider. Moreover, the interrelations of the three streams of data intertwine and interweave across the face of the symbolic structure each influencing one another in terms of the final colouring of each stripe. Unlike most Quantified Self tracking systems, this allows the system to represent the complex and subtle nuances of the experience as it unfolds across the canvas. The protocol is simple in its premise, technical in its execution and complex in its articulation of the subject, i.e. the experience of cycling. And while recognisable features are not instantly identifiable they can be deciphered from the image. This connects neatly back to the idea raised by Fulton. Can the object compete with the experience? I think the answer remains a resolute, 'No'. Figure 12 doesn't quite capture how painfully cold the author's hands and feet were that day (although admittedly they were turning a similar colour) but what it does do is reopen the debate that emerged during the dematerialisation of the art object in the 1960's about exoteric and esoteric art forms.

Iconic representations of places such as photographs show what a place looked like and tend towards the objective end of representation. From them a certain amount of information can be assumed about what it must have been like to be there, E.g. the barren landscape, the strong light and implied heat from the sun. These are exoteric outputs that describe experiences from the outside. By contrast esoteric art forms come from the subjective end of the representational spectrum. They try to express what things actually feel like rather than just look like. The question is, does digital data such as heart rate data (which is essentially an objective measure) get closer to describing experiences from the inside? Is it more esoteric? Arguably, it could be. While any

mediated representation is never the direct experience, personal body data such as heart rate is much closer to sensations of being. It is a view of the inside, and just as one can imply the sense of being in a landscape by looking at a picture of it, arguably, one can imply a sense of experience from looking at data. Heart rate data, along with galvanic skin response is often used to establish emotional responses and stress levels in psychological studies and both are key components of the lie detector test. In the work presented here too, it is the combination of data that is important. Being-in-the-world is not easily disentangled into subjective vs objective experiences. Experiences are embedded in the world by bodies that are deeply intertwined in their surroundings, as Heidegger and other phenomenologists have pointed out (Heidegger, 1962, Merleau-Ponty, 1962) in this context heart rate data is related to speed and altitude to give a broader understanding of why it is so. The picture that is presented is one of the embodied and embedded experiences of cycling in the landscape. The all consuming pain and stress of climbing a steep mountain on a bike is visible towards the red/orange end of the spectrum, while the calm and relief of an easier gradient is evident towards the green/blue. Anyone who has cycled at the limits of their physical ability would recognise these sensations and while the representation may not capture the entirety of an interior experience; surely it is closer than a photograph?

By experimenting with cycling as an art form and software protocols as a way of visualising data from the cycling experience, arguably the author has engaged, not in a re-materialization of the art object (as it never really went away), but in a hyper-materialisation of the data art object. What data brings to experiential art making is an augmentation, a going beyond the established exoteric approaches to representing experiences and towards the personal, more esoteric realm.

One can never really know what another is experiencing, each person's reality is different from the next but is it possible to get closer to expressing what an experience feels like if you are able to use data that is directly related to it? Arguably, the stripe paintings are an attempt at doing just that and it is in the combination of the data that the story of the muddled and entangled experience of Being-in–the-world, as Heidegger called it, is told.

Perhaps, such art works are just another piece of ephemera. Perhaps, in combination with other forms of outcome, more can be expressed about the experience of being-in-the-world. In the same way that the dematerialisation of the art object led to ephemera that spoke of the ideas or experiences of artists in the 1960-70s. Perhaps the hyper-materialisation of the data object can augment our representation of an experience. Perhaps, photographs, videos, audio-recording, field notes, writing and various other forms of data can work together as assemblages of interconnected forms that speak more deeply of how we experience the world around us particularly as our reality and experiences of it are becoming increasingly augmented by digital technologies anyway. For example, if the author had had temperature gauges on his hands and feet during the snowy excursion perhaps an even more detailed picture of the experience might have emerged.

While the development of the authors practice is still in its infancy, it's safe to say that data arts on the whole are on rise. More and more artists are becoming interested in data, as data becomes more and more a part of our lives. To this end, the author intends to continue developing his practice to further explore the role of data in making art about the experience of cycling. One area for further work is to consider the role of time in the execution of work. Up till now the stripe paintings take the duration of a ride and turn it into a spatial arrangement of the data in the image. It should be

quite possible to visualise the same data over time and this in turn will have a significant impact on how outcomes are realized aesthetically. At the moment the stripe paintings exist in both digital and printed format, some emulating real paintings hanging on walls in galleries and offices. Moreover, physical body movement, although mentioned in the author's methods section [iPhone 2 data], has not at this point been activated in the visualisations. Again along with time this will play a fundamental role in future iterations of data collection and software protocols that may emerge as some kind of animation or time based installation. At present none of this is clear. What is clear though is that through further investigation, making art from cycling data will continue to develop as a viable art practice that explores the boundaries between esoteric and exoteric representations of experiences.

References

Benyon, D., Smyth, M., O'Neill, S., McCall, R., Carroll, F., 2006. "The Place Probe: Exploring a Sense of Place in Real and Virtual Environments." *Journal of Presence: Teleoperators and Virtual Environments*, Special Issue: VR Design and Usability Workshop, Vol 15(6), pp 668-687, MIT Press: Massachusetts.

Boden, M. A., and Edmonds, E. A. 2010. What is generative art?. *Digital Creativity*. 20:1-2, 21-46, DOI: **{** HYPERLINK "https://doi.org/10.1080/14626260902867915" **}**

Bull, S. and Kay, J. 2009 Tutorial Notes On Categorisation and Educational Benefits of Open Learner Models (OLM), *14th Annual Conference on Artificial Intelligence in Education*, Brighton, UK.

Chloe Fan, Jodi Forlizzi, and Anind K. Dey, 2012. "A spark of activity: exploring informative art as visualization for physical activity." Paper presented at the ACM Conference on Ubiquitous Computing. ACM.

Choe, E. K., Lee, N. B., Lee, B., Pratt, W., & Kientz, J. A. 2014. "Understanding quantified-selfers' practices in collecting and exploring personal data". In Proceedings of the 32nd annual ACM conference on Human factors in computing systems (pp. 1143-1152). ACM.

Edmonds, E. 2013. Logics for constructing generative art systems, *Digital Creativity*, 14:1, 23-28.

Frick, L. 2014-2015a. *TimeBlocks*, **{** HYPERLINK "http://www.lauriefrick.com/time-blocks/" **}**, Accessed October 23rd 2017

Frick, L. 2014-2015b. *Floating Data*, **{** HYPERLINK "http://www.lauriefrick.com/floating-data/" **}**, Accessed October 23rd 2017

Fulton H. 2001. *Walking Artist*, Richer Verlag, Dusseldorf, Germany.

Gakhal, I. & Bull, S. 2008. An Open Learner Model for Trainee Pilots. *Association for Learning Technology Journal*, 16(2), 123-135. **{** HYPERLINK "https://www.learntechlib.org/p/102695/" **}**. Retrieved March 22, 2018

Harrison, E. 2003. *The Monthly Sculptures Determined by the Daily Quantification Records*, Goldsmiths College of Art Postgraduate Degree Show.

Harrison, E. 2006. *Timelines*, installed at HKW, Berlin (Germany) as part of Transmediale 2015.

Harrison, E. 2009. *Confessions of a Recovering Data Collector*, Plymouth College of Art.

Heidegger, M. 1962. *Being and Time*. Translated by **{** HYPERLINK "https://en.wikipedia.org/wiki/John_Macquarrie" \o "John Macquarrie" **}** & Edward Robinson. SCM Press: London.

Huang, D., Tory, M., Aseniero, B,. A., Bartram, L., Bateman, S., Carpendale, S., Tang, A., and Woodbury, R. 2014 Personal Visualization and Personal Visual Analytics. *IEEE Transactions on Visualization and Computer Graphics*, 21:420-433.

Istomina, T. 2015. *Laurie Frick: The future and present of data art*, Metaleptic.

Kay, J. and Kummerfeld, B. 2009 Lifelong User Modeling Goals, Issues and Challenges, in *Proceeding of the Lifelong User Modeling Workshop, UMAP'09 User Modeling Adaptation and Personaliziation*, pp27-34.Trento, Italy.

Kay, J. and Kummerfeld, B. 2009a. "Preface", *Proceeding of the Lifelong User Modeling Workshop, UMAP'09 User Modeling Adaptation and Personaliziation*. Trento, Italy.

Korzybski, A. 1933. *Science and Sanity: An Introduction to Non-Aristotelian Systems and General Semantics.* The International Non-Aristotelian Library Pub. Co. pp. **{** HYPERLINK "https://books.google.com/?id=WnEVAQAAIAAJ&q=%22A+Non-

aristotelian+System+and+Its+Necessity+for+Rigour+in+Mathematics+and+Physics%22+747" **}**.

Lippard, L. R. 1973. *Six Years: The Dematerialization of the Art Object from 1966-1972*, Studio Vista: London.

Long, R. 1994. *Richard Long*, Electra: Milan.

Lupi, G. & Posavec, S. 2016 *Dear Data*, Particular Books, Penguin Random House, UK.

Lupton, D. 2016. *The Quantified Self*, Polity Press, Cambridge, UK.

Malone, L., and Adams, D. 1997. *JFK*, IMX: Marseille

McCall, R. O'Neill, S. Carroll, F. Benyon, D. and Smyth, M. 2005. Responsive Environments, Place and Presence. *Psychnology Journal special edition on Space, Place and Technology: Human presence in mediated experiences*, Gamberini L, Riva G, Spagnolli A (Eds), Vol 3(1). p35-73. **{** HYPERLINK "http://www.psychnology.org/pnj3(1)_space_place_and_technology.htm" **}**

Merleau-Ponty, M. (1962) *Phenomenology of Perception*, Routlege and Kegan Paul, UK.

O'Neill, S., 2009. *Interactive Media: The Semiotics of Embodied Interaction*, Springer, UK.

O'Neill, S.J. (forthcoming) The Artist as Model User. *The Journal of Personalization Research.* Special Issue on Harnessing Personal Tracking Data for Personalization and Sense-making. UMUAI.

O'Rourke, K. 2013. *Walking and Mapping: Artists as Cartographers*, Leonardo Book Series, The MIT Press: Cambridge, Massachusetts.

Reas, C. Fry, B. Processing 2007. *A Programming Handbook for Visual Designers and Artists*, MIT Press: Cambridge, Massachusetts

Runge, N., Schöning, J., Malaka, R., and Frigo, A. 2016. *You Can Touch This: Eleven Years and 258218 Images of Objects*. Paper presented at the CHI Conference Extended Abstracts on Human Factors in Computing Systems. ACM.

Thudt, A., 2018. **{** HYPERLINK "http://innovis.cpsc.ucalgary.ca/Publications/_Thudt:2018:phd" ***}***. PhD thesis, University of Calgary, Calgary, Alberta, Canada,

Thudt, A., Baur, D., and Carpendale, S., 2014. **{** HYPERLINK "http://innovis.cpsc.ucalgary.ca/Publications/_ThudtDIS14" **}**. In *Proceedings of*

the DIS'14 Workshop on A Personal Perspective on Visualization and Visual Analytic, DIS 2014, Vancouver, BC, Canada.

Thudt, A., Baur, D., Huron, S., and Carpendale, S., 2015. Visual Mementos: Reflecting Memories with Personal Data. *Visualization and Computer Graphics, IEEE Transactions on Visualization and Computer Graphics*. 22:1, 369-378.

Tuan, Y. F. 1977. *Space and Place: The Perspective of Experience*. University of Minnesota Press: Minneapolis, MN. **{** HYPERLINK "https://en.wikipedia.org/wiki/International_Standard_Book_Number" \o "International Standard Book Number" **} {** HYPERLINK "https://en.wikipedia.org/wiki/Special:BookSources/0-8166-0808-3" \o "Special:BookSources/0-8166-0808-3" **}**.

Wolf, G. 2009. "Know Thyself: Tracking every facet of life, from sleep to mood to pain, 24/7/365".*Wired*. Http//archive.wired.com/medtech/health/magazine/17-07/lbnp_knowthyself (accessed September 15th, 2017).